Chapter 23 Open Reduction and Internal Fixation of Jones Fracture

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DEFINITION

- A Jones fracture represents an acute injury at the metaphyseal–diaphyseal junction of the fifth metatarsal. The fracture should not have extension distal to the fourth–fifth intermetatarsal articulation (**FIG 1**).
- This fracture is often seen as a result of sporting or athletic activities.
- The fracture begins on the lateral aspect of the fifth metatarsal and may propagate into the metatarsocuboid joint.
- Three subsets of the fracture exist, as described by Torg (**FIG 2**):
  - Type 1: Acute fracture where the fracture line has sharp margins and no intramedullary sclerosis. Often involves only the lateral cortex.
  - Type 2: Delayed union where fracture line involves both cortices with associated periosteal bone formation, widening of the fracture line, and evidence of intramedullary sclerosis
  - Type 3: Nonunion demonstrated by bone resorption with radiolucency at the fracture line and obliteration of the medullary canal by sclerotic bone[14]

ANATOMY

- There are two major motor insertions onto the fifth metatarsal:
  - The peroneus brevis inserts onto the dorsal aspect of the fifth metatarsal tubercle.
  - The peroneus tertius inserts onto the dorsal aspect of the metatarsal at the metaphyseal–diaphyseal junction.
- The plantar fascia has a strong insertion along the plantar aspect of the fifth metatarsal.
- The shaft is supplied by a single nutrient artery that enters from the medial cortex at the junction of the proximal and middle thirds of the diaphysis. The base and tuberosity are supplied by secondary epiphyseal and metaphyseal arteries (**FIG 3**).[12,13]

PATHOGENESIS

- Acute Jones fractures are the result of plantarflexion at the ankle and adduction of the forefoot.
- Tensile forces along the lateral border of the metatarsal result in a transverse fracture.
- They are typically the result of sporting or athletic events, with many instances described in football and basketball players.
- This should not be confused with a diaphyseal stress fracture, where the athlete describes prodromal symptoms that have existed for weeks to months. Radiographic assessment of this type will demonstrate signs of a stress reaction.[2]

NATURAL HISTORY

- The Jones fracture was originally described in 1902 by Sir Robert Jones, who described a transverse fracture at the metaphyseal–diaphyseal junction in four individuals, including himself.[5]
- The natural history and outcomes of nonoperative and operative treatment are difficult to determine because many published reports include a mixture of acute Jones fractures and diaphyseal stress fractures.
- Various studies have examined nonoperative versus operative treatment.
- Operative treatments have included internal fixation with or without bone grafting and bone grafting alone.
- Nonoperative treatment of the acute fracture is associated with an increased risk of delayed or nonunion due to the watershed blood supply at the metaphyseal–diaphyseal junction in the metatarsal.

PATIENT HISTORY AND PHYSICAL FINDINGS

- The patient may describe participation in an athletic event where, after a particular maneuver, there is an acute onset of pain over the lateral border of the foot.
- The patient may have swelling and ecchymosis over the lateral border of the foot.
- Pain will be elicited with direct palpation over the base of the fifth metatarsal.
- Physical examination should include:
  - Direct palpation over the base of the fifth metatarsal: Pain in this region increases suspicion of injury.
  - Direct palpation over the tarsometatarsal joint complex: Pain indicates possible injury to the Lisfranc complex.
  - Passive dorsiflexion–plantarflexion of individual metatarsal heads: Pain indicates possible injury to the Lisfranc complex.
  - Attempted single-limb heel lift: Pain indicates possible injury to the Lisfranc complex.

IMAGING AND OTHER DIAGNOSTIC STUDIES

- Radiographs of the affected foot, including anteroposterior, lateral, and oblique, are sufficient to diagnose an acute Jones fracture.
- Weight-bearing radiographs of the affected foot are obtained to rule out a Lisfranc injury.

DIFFERENTIAL DIAGNOSIS

- Diaphyseal stress fracture
- Avulsion fracture of the base of the fifth metatarsal
- Lisfranc sprain or subluxation
- Cuboid fracture

NONOPERATIVE MANAGEMENT

- Non-weight bearing in a short-leg cast for 6 weeks, followed by weight bearing in a walker boot for an additional 6 weeks

FIG 1 • Acute Jones fracture. The fracture line is at the junction of Zones 1 and 2; there is no cortical hypertrophy or periosteal reaction.

- Torg's series of 15 patients demonstrated a 93% union rate at an average of 6.5 weeks.[14]
- Clapper reported union in 72% of acute Jones fractures treated with a non-weight-bearing short-leg cast for 8 weeks followed by weight bearing in a cast or walker boot.[1]

SURGICAL MANAGEMENT

- The indications for surgical fixation of an acute Jones fractures have not been clearly defined.
- High-performance athletes or individuals desiring a quicker return to activity may benefit from intramedullary screw fixation, as this provides a more predictable and shorter recovery period.

Preoperative Planning

- If percutaneous screw fixation of the fifth metatarsal is planned, preoperative measurement of the intramedullary canal will ensure that the proper hardware is available.

Positioning

- The patient should be placed in the supine position on a radiolucent table.
- A bolster should be placed under the ipsilateral buttock to increase the exposure to the lateral aspect of the foot.
- A C-arm image intensifier is used to assist in the operative procedure. It is helpful to have the entire limb draped free so that the knee may be flexed past 90 degrees. This will also facilitate imaging of the foot (**FIG 4**).

FIG 2 • Torg type II diaphyseal stress fracture. Widening of the fracture line and periosteal bone formation are shown.

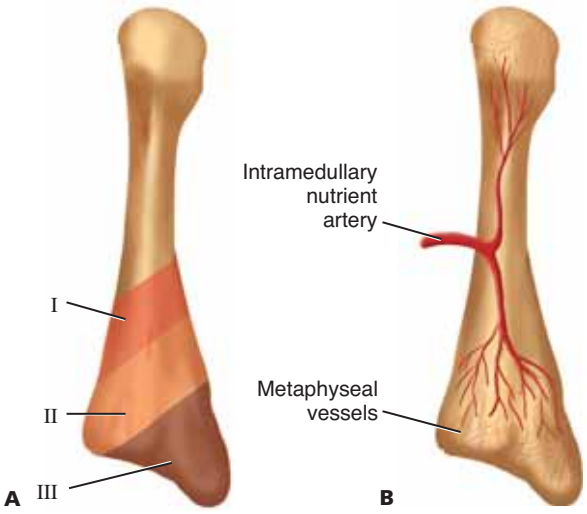


FIG 3 • **A.** The three anatomic and clinical zones for fractures of the proximal fifth metatarsal. **B.** Arterial blood supply of the fifth metatarsal.

FIG 4 • Fluoroscopic control; flexion of the knee past 90 degrees allows AP imaging.

- A tourniquet is not required but may be chosen based on surgeon preference.

Approach

- A dorsolateral approach to the base of the fifth metatarsal is preferred.
- A longitudinal incision is made over the base of the fifth metatarsal.
- Skin flaps are developed.
- The peroneus brevis tendon is identified as it inserts onto the base of the fifth metatarsal.

TECHNIQUES

PERCUTANEOUS INTRAMEDULLARY SCREW FIXATION

Incision and Dissection

- A 2- to 3-cm incision is made parallel to the plantar surface of the foot.
- The incision should begin 2 cm proximal to the tip of the fifth metatarsal tuberosity. The location should be confirmed with a C-arm image (**TECH FIG 1**).
- Blunt dissection is used to expose the tuberosity.

Screw Portal Creation and Guidewire Placement

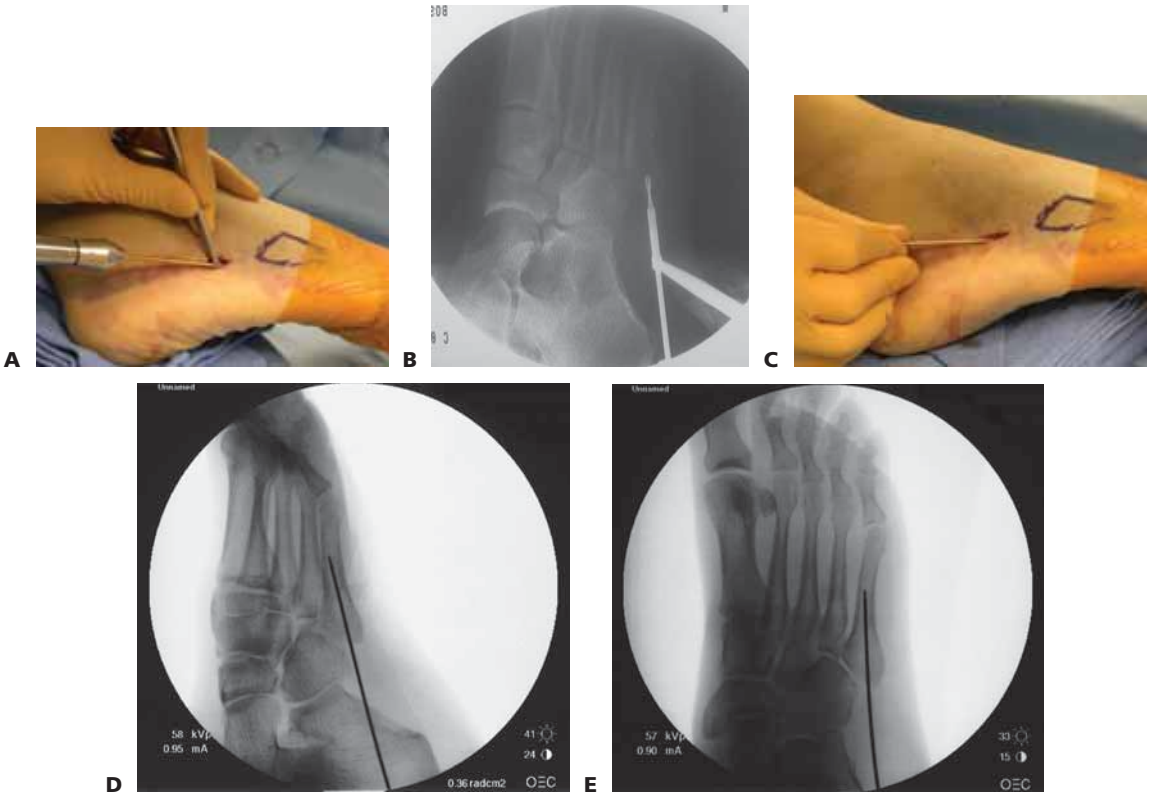
- With a drill guide used to protect the soft tissues, a 2.5-mm drill is used to open the entry portal for the screw.
  - The correct entry site is one that is in line with the medullary canal just medial to the tip of the tuberosity (**TECH FIG 2A**).

TECH FIG 1 • Skin incision proximal to tuberosity.

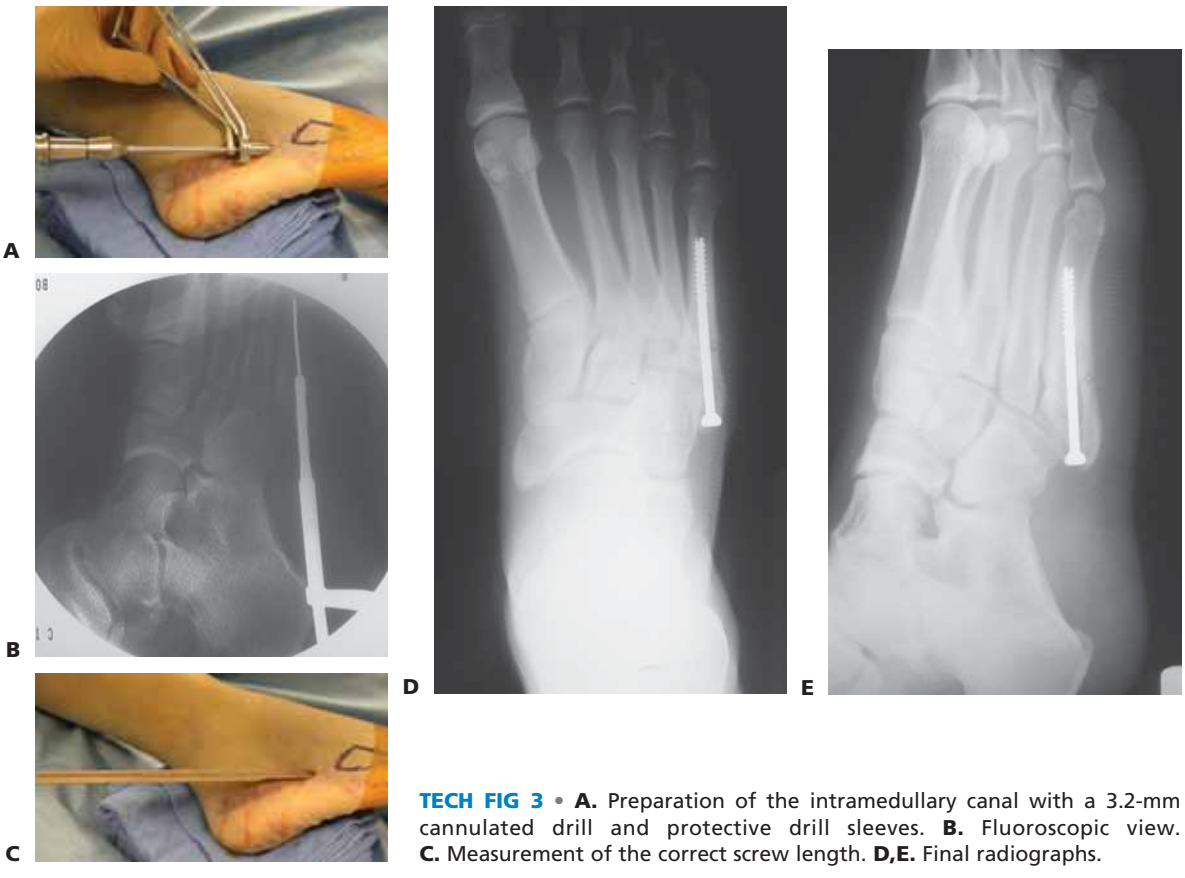
  - The correct starting position is confirmed with a C-arm image (**TECH FIG 2B**).
- The surgeon advances the drill down the medullary canal, ensuring that the drill passes the fracture site. This should be performed under biplanar C-arm guidance to ensure proper depth.
- Leaving the drill guide in place, the surgeon removes the drill and places a guidewire down the intramedullary canal (**TECH FIG 2C**).
  - The guidewire is advanced by hand to ensure the cortex is not violated.
- Proper placement of the guidewire is confirmed with biplanar C-arm images (**TECH FIG 2D,E**).

Screw Placement

- The surgeon reams the intramedullary canal with a 3.2-mm cannulated drill, leaving the drill sleeve in place to protect soft tissues (**TECH FIG 3A,B**).
  - The drill should be passed distal to the fracture site.
- The proximal end is then reamed with a 4.5-mm drill. This facilitates countersinking the screw to avoid soft tissue irritation.
- The surgeon uses the guidewire to measure the proper length of the screw required (**TECH FIG 3C**).
- The surgeon places an appropriately sized 4.5-mm, partially threaded AO screw with a small profile head into the intramedullary canal (**TECH FIG 3D,E**).
- In larger individuals, a 6.5-mm screw may be substituted, using the appropriately sized drills to create the starting portal and to overream the proximal cortex.



TECH FIG 2 • **A.** Creation of the starting portal with a 2.5-mm drill bit and drill guide. **B.** Fluoroscopic confirmation of entry placement. **C.** Insertion of a flexible guidewire down the intramedullary canal. **D,E.** Fluoroscopic confirmation of guidewire placement.

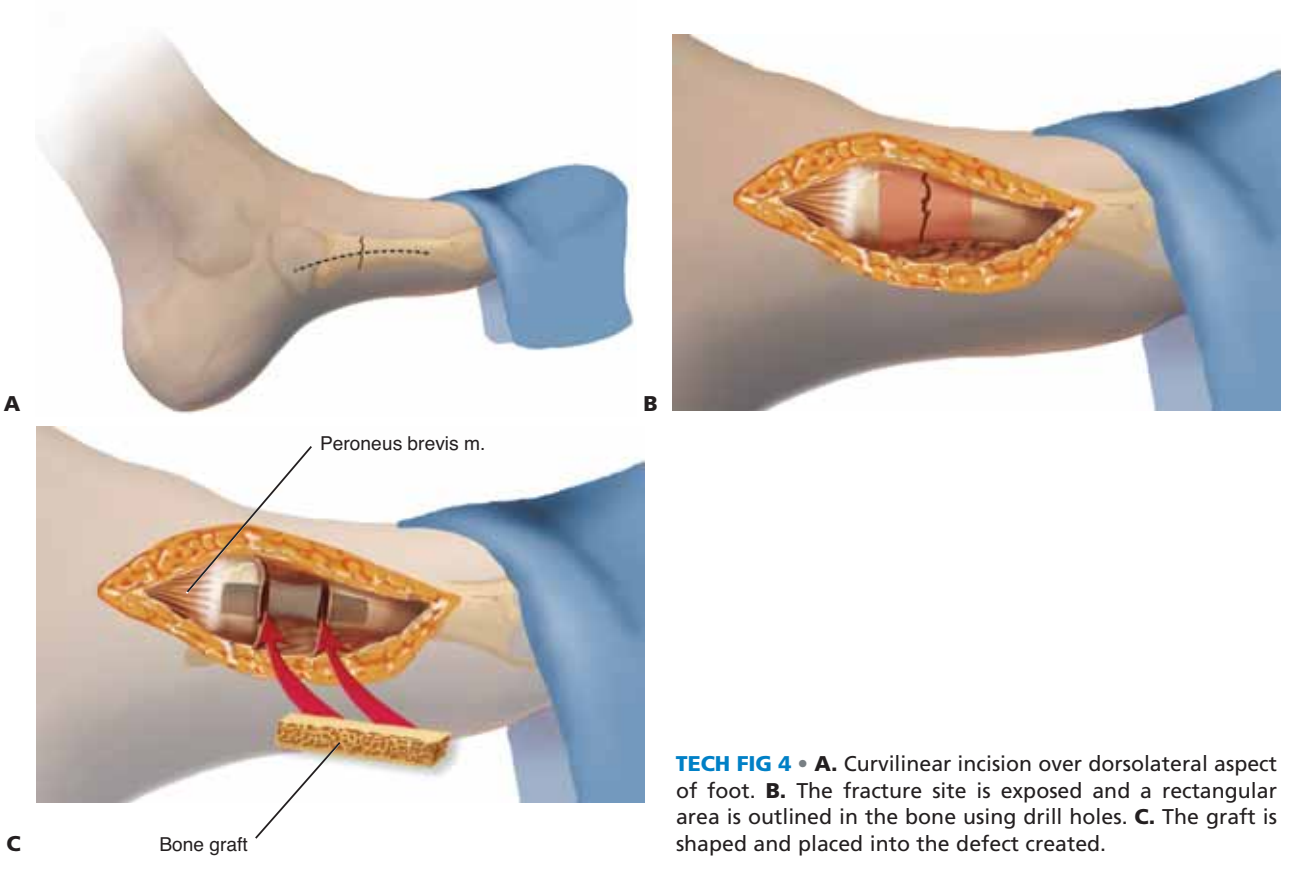


TECH FIG 3 • **A.** Preparation of the intramedullary canal with a 3.2-mm cannulated drill and protective drill sleeves. **B.** Fluoroscopic view. **C.** Measurement of the correct screw length. **D,E.** Final radiographs.

TECHNIQUES

INLAY BONE GRAFTING WITHOUT INTERNAL FIXATION

- The technique is similar to the Russe technique for scaphoid nonunion.[11,14]
- The base of the fifth metatarsal is approached through a curvilinear dorsolateral incision (**TECH FIG 4A**).
- The fracture site is exposed subperiosteally and a rectangular section of bone measuring 0.7 × 2.0 cm centered over the fracture is outlined by four drill holes.
- A sharp osteotome is used to remove the outlined section of bone (**TECH FIG 4B**).
- The medullary canal is then curetted, drilled, or both until all of the sclerotic bone has been removed and the canal has been re-established.
- An autogenous corticocancellous bone graft with the same measurements as the removed fragment is then removed from the anteromedial aspect of the distal end of the tibia.
- The graft should be contoured so that the cortical portion of the graft fits accurately into the rectangular defect and does not obstruct the medullary canal (**TECH FIG 4C**).
- The periosteum, subcutaneous tissue, and skin are then closed.
- To avoid a stress riser, the bone removed from the fifth metatarsal is placed into the tibia defect before wound closure.
- The patient is then immobilized in a non-weight-bearing cast.



TECH FIG 4 • **A.** Curvilinear incision over dorsolateral aspect of foot. **B.** The fracture site is exposed and a rectangular area is outlined in the bone using drill holes. **C.** The graft is shaped and placed into the defect created.

PERCUTANEOUS INTRAMEDULLARY SCREW FIXATION WITH LOCAL BONE GRAFT

- The procedure is performed as described for percutaneous intramedullary screw fixation.[8]
- Once the medullary canal has been overdrilled over the guidewire, the wire is removed.
- A slender curette is advanced to the depth of the fracture and manipulated to add a mass of cancellous bone to the fracture site.
- Care should be taken to limit procurement of bone to within 7 mm of the fracture site.
- Once the local bone grafting has been completed, the wire is reintroduced into the canal.
- The intramedullary screw is placed as described for percutaneous intramedullary screw fixation.

PEARLS AND PITFALLS

Failure of hardware	■ A 4.5-mm screw or larger is used when possible.
Failure of hardware	■ Touch-down weight bearing in a walker boot is used for 6 to 8 weeks. Weight bearing is advanced only when radiographic evidence of fracture healing is observed.

POSTOPERATIVE CARE

- Immediately after surgery, the patient should be immobilized in a walker boot and should be limited to touch-down weight bearing for 6 to 8 weeks.
- During this period, range of motion and gentle strengthening may be allowed.
- After 6 to 8 weeks, weight bearing and boot removal are allowed when radiographic evidence of healing is observed.
- Return to full activity, especially competitive athletics, is allowed only when complete healing is observed on radiographs in three planes: anteroposterior, lateral, and oblique.
- Functional bracing or orthosis is recommended for individuals returning to athletic activities.

OUTCOMES

- Portland et al[10] treated 15 patients with acute Jones fracture or Torg type I fracture and achieved 100% union at an average of 6.25 weeks.
- DeLee et al[3] reported 100% success in acute Jones fractures treated with percutaneous intramedullary screw fixation. No complications were reported.
- Mindrebo et al[9] treated nine patients with acute Jones fractures with outpatient intramedullary screw fixation and had 100% union at an average of 6 weeks. One patient had the screw removed because of theoretical concerns over screw breakage.

COMPLICATIONS

- Refractures and nonunions may occur when small-diameter screws are used. Screws less than 4.5 mm have been shown biomechanically to be weaker than larger screws. Using the largest-diameter screw where all of the screw threads cross the fracture site has been demonstrated to provide the best biomechanical fixation.
- Refractures and nonunions may occur when the patient returns to early weight bearing and when the Jones fracture is fixed in elite-level competitive athletes who may push themselves to return to activities before union has occurred.

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